CLAIMS

We claim:

1. A method of addition in a modular arithmetic system, said method comprising the steps of:

providing a first number;

providing a second number;

providing a volume of phase change material, said phase change material having a plurality of states, said states including: a reset state, a set state obtainable from said reset state by applying energy in an amount corresponding to the set energy of said reset state, said set state having lower resistance than said reset state, and one or more intermediate states having substantially the same resistance as said reset state, said one or more intermediate states being obtainable from said reset state by applying energy in an amount less than said set energy of said reset state;

applying a first set of energy pulses to said phase change material, the number of applied energy pulses in said first set equaling said first number; and

applying a second set of energy pulses to said phase change material, the number of applied energy pulses in said second set equaling said second number.

2. The method of claim 1, wherein said phase change material comprises a chalcogen.

3. The method of claim 1, wherein said phase change material comprises Te.

4. The method of claim 1, wherein said phase change material comprises Te and Se.

5. The method of claim 2, wherein said phase change material further comprises Ge.

6. The method of claim 2, wherein said phase change material further comprises Sb.

7. The method of claim 2, wherein said phase change material further comprises a transition metal element.

8. The method of claim 2, wherein said phase change material further comprises In, Ag, Bi, Pb, Sn, As, or P.

9. The method of claim 1, wherein the resistance of said set state is at least a factor of ten lower than the resistance of said reset state.

10. The method of claim 1, wherein said first and second sets of applied energy pulses include electrical or optical energy pulses.

11. The method of claim 1, wherein the energy of at least one of said applied energy pulses in said first set or said second set of energy pulses is less than said set energy of said reset state.

12. The method of claim 1, wherein the energy of each of said applied energy pulses in said first set or said second set of energy pulses is less than said set energy of said reset state.

13. The method of claim 1, wherein said energy pulses of said first set of applied energy pulses are equal in energy.

14. The method of claim 13, wherein said energy pulses of said second set of applied energy pulses are equal in energy.

15. The method of claim 1, wherein said energy pulses of said first set of applied energy pulses are equal in amplitude.

16. The method of claim 1, further comprising the step of resetting said phase change material, said resetting step occurring prior to said applying first set of energy pulses step.

17. The method of claim 1, further comprising the step of resetting said phase change material each time it sets during said applying first set of energy pulses step.

18. The method of claim 1, further comprising the step of resetting said phase change material each time it sets during said applying second set of energy pulses step.

19. The method of claim 1, further comprising the step of measuring the resistance of said phase change material.

20. The method of claim 1, further comprising the step of setting said phase change material, said setting step occurring after said applying second set of energy pulses step.

21. The method of claim 1, further comprising the steps of

providing the modulus of a modular arithmetic system;

programming said phase change material according to said modulus, said programming including defining programming states, said programming states being selected from said plurality of states of said phase change material, said programming states including said reset state and said set state, the number of said programming states being one more than said modulus.

22. The method of claim 21, wherein each of said energy pulses applied during said applying first set of energy pulses step or said applying second set of energy pulses step transforms said phase change material from one of said programming states to another of said programming states.

23. The method of claim 21, wherein said applying first set of energy pulses step or said applying second set of energy pulses step comprises the steps of:

transforming said phase change material to said reset state;

A. incrementing said phase change material, said incrementing including providing an energy pulse having sufficient energy to transform said phase change material to a different one of said programming states;

B. iteratively repeating said incrementing step A until said phase change material is transformed to said set state;

C. resetting said phase change material and

D. iteratively repeating the above steps A, B, and C until all of said energy pulses of said first set of energy pulses or said second set of energy pulses have been applied.

24. The method of claim 23, further comprising the step of setting said phase change material, said setting step occurring after said applying second set of energy pulses step, said setting step including the steps of

E. incrementing said phase change material, said incrementing including providing an energy pulse having sufficient energy to transform said phase change material to a different one of said programming states;

F. iteratively repeating said incrementing step E until said phase change material is transformed to said set state.

25. The method of claim 24, further comprising the step of counting the number of increments required to transform said phase change material to said set state.